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SPECIFICATIONS FOR ALL UNITED STATES FOREST SERVICE
FREQUENCY-MODULATED RADIOPHONES AND ACCESSORIES //

1. Terminology
2. Standard Test Conditions
3. Instability
4. Ratings and Components
5. Finish
6. Instructions and Markings
7. Vibration
8. Overload Protection
9. Tuning Range
10. RF Impedance
11. Pilot Lights
12. Meters
13. Metering
14. Controls
15. Local Test Controls
16. Primary Power
17. Housings
18. Receiver Type
19. Receiver Injection Frequency
20. Receiver Channel Arrangement
21. Receiver Selectivity
22. Receiver Noise Quieting Sensitivity
23. Receiver Signal to Noise Sensitivity
24. Receiver Temperature Stability
25. Receiver Audio-Power Output
26. Receiver Audio-Frequency Response
27. Receiver Squelch
28. Receiver Residual Noise
29. Receiver Spurious Response
30. Transmitter Channel Arrangement
31. Transmitter Frequency Control
32. Transmitter Frequency Adjustment
33. Transmitter RF-Power Output
34. Transmitter Modulation
35. Transmitter Deviation
36. Transmitter Deviation Characteristics
37. Transmitter Deviation Limiter
38. Transmitter Amplitude Modulation
39. Transmitter Residual Frequency Modulation
40. Transmitter Temperature Stability
41. Transmitter Spurious Emission
42. Automatic Repeater Operation
43. Accessories



1. Terminology. Within the meaning of these specifications:
 - "Low-Band" shall refer to equipment designed for operation in the 30 to 40 megacycle sub-band.
 - "High-Band" shall refer to equipment designed for operation in the 162 to 174 megacycle sub-band.
 - "Ultrahigh-Band" shall refer to equipment designed for operation in the 406 to 420 megacycle sub-band.
 - "Narrow-Band" shall refer to equipment normally employing a maximum deviation of plus and minus 5 kilocycles.
 - "Wide-Band" shall refer to equipment normally employing a maximum deviation of plus and minus 15 kilocycles.
 - "Local Control" shall refer to equipment incorporating all specified operator control functions and adjustments on or immediately adjacent to the basic unit.
 - "Extended Local Control" shall mean equipment designed so as to permit all normal operator control functions at distances up to 200 feet from the basic unit. See paragraph 14 for control cable requirements.
 - "Remote Control" shall refer to equipment designed to provide all normal operator control functions over a 2-wire line or cable of standard telephone type construction.
 - "Light-Portable Radiophones" shall refer to man-carried portable radiophones of nine (9) pounds or less.
 - "Packsets" shall refer to man-carried portable radiophones of twelve (12) pounds or more.
 - "AC Mobile" shall refer to a radiophone of a size and shape similar to the usual mobile radiophone but equipped to operate from 110-120 volt, 60 cycle, AC power source and for use at a fixed location. The AC power supply chassis shall be housed within the basic unit case and not supplied as an accessory.
2. Standard Test Conditions.
 - Standard Test Frequency shall be either (a) the specified operating frequency or (b) a frequency near the middle of the applicable sub-band.
 - Standard Test Modulation shall be 70 percent of the maximum rated system deviation at 1,000 cycles per second.
 - Standard Test RF Input Signal shall be measured in terms of microvolts across the receiver input terminals when the receiver is connected to a generator having a source impedance of 50 ohms; or when the receiver is connected to a line of 50 ohms characteristic impedance which is properly terminated at the generator; or when the receiver is connected to a properly terminated matching device presenting 50 ohms source impedance to the receiver.
 - Standard Test RF Signal Input Power shall be expressed in decibels below 1 watt under matched conditions.
 - Standard Receiver Test Output Power shall be the audio-frequency power output as detailed in paragraph 25.
 - Standard Receiver Deemphasis is a falling response of 6 decibels per octave over the usable audio range.

Standard Noise Quieting Ratio for Receiver Test shall be 20 decibels at the receiver output.

Standard Receiver Signal + Noise + Distortion to Noise + Distortion Ratio shall be 12 decibels.

Standard Room Temperature for alignment and applicable testing shall be 27° Centigrade plus or minus 5° Centigrade.

Standard Range for Extended Temperature Tests shall be minus 30° Centigrade to plus 60° Centigrade for all central station and mobile type equipment, and minus 20° Centigrade to plus 50° Centigrade for all dry-battery powered type equipment.

Standard Power Supply Test Voltage is the primary voltage applied to the input end of the power cable normally supplied with the equipment. Standard test voltages shall be as follows:

<u>Nominal Power Supply Voltage</u>	<u>Operating Current</u>	<u>Test Voltage</u>
6 Volt	(2A	6.6
	(15A	6.5
	(40A	6.3
	(60A	6.2
	(80A	6.1
12 Volt	(2A	13.8
	(15A	13.6
	(27A	13.4
	(40A	13.2
110/120 Volt		117
Dry Batteries		90% of nominal

* Standard Dry-Battery Equipment Test Duty Cycle. The test duty cycle for all dry-battery powered equipment shall consist of 8 hours continuous operation of 1 minute transmit and 9 minutes reception of a signal modulated 12 DB below the maximum rated system deviation, followed by a 16-hour rest period.

3. Instability. Equipment will not be considered acceptable that displays instability due to regeneration, feedback, vibration, or other causes that tend to make the receiver or transmitter critical in tuning or unstable in operation.
4. Ratings and Components. Ratings of capacitors, resistors, relays, switches, and all other components shall provide adequate safety factor in accordance with modern engineering practices for commercial radio communication equipment. All tubes shall be operated in a manner to conform with ratings and recommendations for the intended service as specified by tube manufacturers. All tubes shall be of standard production types produced by reputable tube manufacturers and readily available through a system of distributors at the time the equipment is delivered. All component parts shall equal or exceed the requirements of the Radio Electronics Television Manufacturers Association.

5. Finish. Painted, enameled, or lacquered surfaces, where used, shall conform to the best automotive or Army-Navy standard practices for application of baked enamel or lacquer over a rust inhibiting or rust resisting plate or primer.
6. Instructions and Markings. One complete set of instructions for installation and maintenance shall be furnished with each central station and one complete set for each destination of all other types of equipment. The manufacturer may be required to furnish additional copies as enumerated in the item list of the bid invitation.

All basic unit packages, cartons, or crates shall be plainly marked with the following minimum information:

 - (1) Name and address of consignee.
 - (2) Equipment type and/or model.
 - (3) Operating frequency or frequencies.
 - (4) Serial numbers (when they identify the complete unit).

If accessories are packaged separate from the basic unit, not more than one group for a unit shall be placed in the same carton or package and each package shall be plainly labeled to indicate the basic unit with which it is associated.
7. Vibration. All mobile and portable equipment shall be so constructed mechanically and electrically as to withstand a shock test of 5g's and a vibration test as indicated below, during and after which there shall be no visible evidence of damage or detectable impairment of performance. The equipment shall be vibrated over a frequency range of 10-30 cycles per second at an amplitude of 0.060 inches (total excursion 0.120 inches) and over the frequency range of 30-60 cycles per second at an amplitude of 0.015 inches (total excursion 0.030 inches) for not less than 8 minutes over each frequency range and in each of the three major planes of vibration.
8. Overload Protection. (a) Equipment designed to operate from AC power sources shall contain, or be supplied with, adequate fuses or other protective devices designed to protect the equipment against accidental overloads or failures due to short circuits within the equipment.

(b) Equipment designed to operate from storage batteries, such as lead-acid vehicular batteries, shall be supplied with a master fuse or other standard protective device in the primary power lead near the supply end.

(c) Equipment receiving primary power from dry batteries shall not require fuses.
9. Tuning Range. (a) Low-band transmitters and receivers shall be capable of being adjusted to any frequency in the 30 to 40 megacycle band without component substitution except that one coil change will be permitted in the final amplifier plate circuit and/or one harmonic filter change permitted.

(b) High-band transmitters and receivers shall be capable of being adjusted to any frequency in the 162 to 174 megacycle band without component substitution.

(c) Ultrahigh-band transmitters and receivers shall be capable of being adjusted to any frequency in the 411 to 416 megacycle band without component substitution.

10. RF Impedance. The radio-frequency input circuit of all receivers and the output circuit of all transmitters shall be designed for operation into unbalanced transmission lines having a nominal impedance of from 35 to 75 ohms.
11. Pilot Lights. (a) Central station and mobile equipment shall have a minimum of one green light indicating primary power "ON", and one red light indicating carrier "ON" or push-to-talk circuit activated, all visible to the operator.
(b) Hand portable units or equipment deriving power from dry batteries will not require pilot lights.
12. Meters. Central station type equipment shall have a minimum of one final amplifier plate or cathode current meter either permanently mounted on the front panel or separately mounted in a durable, attractive case and located so as to be visible for maintenance and operation, and connected to form a permanent part of the final amplifier metering circuit. Meter/s for pole-mount equipment shall be mounted inside the weatherproof enclosure. Meters will not be required with AC mobile, console/compact-vertical, or hand portable type equipment.
13. Metering. Metering facilities for routine checks or complete re-alignment of transmitter/s and receiver/s shall be provided and shall not require the use of other than conventional test instruments such as vacuum tube voltmeters, DC millimeters, or DC microammeters. Metering which can be accomplished only by special test kit, applicable only to one specific type of equipment, is not acceptable.
14. Controls. The central station controls detailed in (a) thru (c) below are to be furnished only when specifically enumerated in the bid item list:
 - (a) Central Station Local Controls may be either on the basic unit or with the handset assembly. In either case, they shall be external of the basic housing, accessible to the operator, and plainly labeled. They shall provide the following facilities and functions.
 - (1) Speaker, which may be part of the basic unit or housed separately for wall or desk mounting.
 - (2) Speaker volume control.
 - (3) Push-to-talk handset with appropriate hang-up-box or cradle connected so as to transfer the audio from the speaker to the handset (at a comfortable level) when the handset is lifted.

- (4) Adjustable squelch control.
- (5) Channel switch. (With multichannel units only).

(b) Central Station Extended Local Control shall consist of a compact unit suitable for desk mounting and capable of providing the required control functions at distances up to 200 feet from the basic unit. Connection shall be by means of a multiwire cable. Conductors in the multiwire cable will not be greater than number 17 AWG and not more than one pair shall be used for each circuit for distances up to 200 feet, except that two pair will be permitted for the low voltage push-to-talk circuit. The multiwire cable will be supplied by the purchaser. Provision shall be incorporated to permit simultaneous attachment of two such control units. The following facilities and functions shall be provided:

(1) Speaker, which may be part of the control unit or housed separately for wall or desk mounting.

(2) Speaker volume control.

(3) Push-to-talk handset with appropriate hang-up box or cradle connected so as to transfer the audio from the speaker to the handset (at a comfortable level) when the handset is lifted. Hang-up box may be part of the control head or separate:

(4) Adjustable squelch control. (Required on only one control unit where two are used).

(5) Channel switch. (With multichannel units only).

(6) Electrical power to perform all required functions shall be obtained from the basic unit. Separate power from battery or power line source will not be permitted.

(c) Central Station Remote Control Unit shall consist of a desk top type cabinet or console designed to provide the following facilities and functions:

(1) Speaker.

(2) Speaker volume control.

(3) The line amplifier shall be capable of producing one watt of audio-power output at the speaker at an input of 0.18 volts rms across the 500-600 ohm input terminals when tested at 1,000 cps. (Gain of approximately 42 decibels).

(4) Push-to-talk handset with appropriate hang-up box or cradle connected so as to transfer the audio from the speaker to the handset (at a comfortable level) when the handset is lifted.

(5) Microphone amplifier having sufficient gain to develop not less than 1.73 volts across 500 ohms from the microphone supplied.

(6) Line level meter.

(7) Pilot light indicating carrier "ON" circuit activated.

(8) Channel switch. (With multichannel units only).

The remote control unit shall be supplied for operation on 110-120 volt, 60 cycle, single phase alternating current. It shall supply all power for the terminating unit function control relays. Hum level shall be at least 40 decibels below full output. It shall be designed to permit simultaneous attachment of up to 3 such units to the control line. The remote control unit shall be capable of providing the required performance over a 2-wire line or cable of standard telephone type construction having losses up to 20 decibels at voice frequencies. It shall be adequately filtered or protected against interference caused by high ambient radio-frequency fields from nearby transmitters.

(d) Mobile Equipment Controls and Facilities shall include:

- (1) Dynamic PM speaker with suitable universal mount and cord for trunk-mount units. Speaker for front-mount units shall be a part of the basic unit.
- (2) Speaker volume control.
- (3) Adjustable receiver squelch control.
- (4) Receiver and transmitter primary power ON-OFF switch.
- (5) Channel selector switch. (With multichannel units only).
- (6) Pilot lights as required. (See paragraph 11).
- (7) Not less than 16 feet of heavy-duty weatherproof control cable shall be supplied with trunk-mount units.
- (8) Connectors or receptacles for attachment of control cable and speaker cable.
- (9) Military type, palm-held, push-to-talk microphone complete with self-retracting cord.

All controls for trunk-mount units shall be incorporated in a small, neat, and durable box of the dash-mounting type. Controls for front-mount units shall be a part of the basic unit.

(e) Packset and Speaker Model Light-Portable Controls and Facilities shall include:

- (1) ON-OFF switch so arranged as to disconnect the primary power when the microphone is replaced.
- (2) Speaker.
- (3) Speaker volume control.
- (4) Variable squelch control.
- (5) Channel selector switch. (With multichannel units only).
- (6) Military type, palm-held, push-to-talk microphone complete with self-retracting cord.

(f) Light-Portable Radiophone Controls and Facilities shall include:

- (1) ON-OFF switch so arranged as to disconnect the primary power when the handset is replaced.
- (2) Push-to-talk handset.
- (3) Channel selector switch. (With multichannel units only).

(g) Automatic Repeater Controls for battery-powered repeaters shall be as outlined under Local Controls (item (a) above) except that a palm-held microphone shall be permitted and that provision shall be included to attach an extended local control unit incorporating the following minimum functions:

- (1) Speaker, which may be part of the control unit or housed separately for wall or desk mounting.
- (2) Speaker volume control.
- (3) Push-to-talk handset with appropriate hang-up box or cradle connected so as to transfer the audio from the speaker to the handset (at a comfortable level) when the handset is lifted.
- (4) Channel switch. (With multichannel units only).
- (5) Adjustable squelch control or squelch disable switch.

If simultaneous operation of both control positions is not economically feasible, provision shall be incorporated for rapid shift of control between the basic unit and the extended local control unit.

15. Local Test Controls. All central station equipment not having operating controls at the basic unit shall be provided with a microphone and speaker to permit local operation for test purposes. AC mobile equipment will not require local test controls.

16. Primary Power. (a) All central station and AC mobile equipment shall be designed to operate from 110-120 volt, 60 cycle, single phase alternating current.

(b) Mobile equipment shall be designed for operation on either a 6 or 12 volt lead-acid vehicle battery. It shall require only minor changes in the basic unit and/or associated accessories to change operation from one voltage to the other. Changes permitted shall include replacement of fuses, pilot lights and plug-in vibrators. Heater and control system changes shall be made by adjusting or changing switch positions, connecting plugs, jumpers and/or external cables. (Rewiring of filament and tube circuits not acceptable). Successful bidders will be required to supply equipment with fuses, pilot lights, vibrators, etc. for operation on only one voltage as indicated on the individual purchase order.

Total current drain for all 6 volt mobile units shall not exceed the following:

<u>Unit</u>	<u>Standby Drain</u>	<u>Transmit Drain</u>
Low-band	12 amperes	30 amperes
Low-band High-power	12 "	50 "
High-band	12 "	35 "
High-band High-power	17 "	55 "
Ultrahigh-band	16 "	45 "

Battery drain figures for 12 volt operation shall not exceed 55 percent of the 6-volt operation figures.

Not less than sixteen (16) feet of heavy-duty weatherproof primary power cable with full length ground return shall be supplied with trunk-mount units, or not less than six (6) feet shall be supplied with front-mount units. When a full length ground cable is not ordinarily included, a short ground lead will be permitted if there is also included an insulated weather-proof conductor for a ground extension, of a size equal or greater than the primary power cable, terminated in suitable connectors and a total length not less than the primary power cable.

(c) Light-Portable Radiophones, Packsets, and Low Power Repeater Equipment shall be designed to operate from dry batteries unless stated otherwise. Such batteries shall be of standard types and generally available on the commercial market at the time of the equipment purchase.

The end point of useful battery life for test purposes shall be that point at which transmitter RF-power output has dropped to 25 percent of the bid specification requirements (down 6 decibels) as outlined in paragraph 33 and when operated at the test duty cycles specified for the applicable equipment.

(d) Low Power Repeater Equipment shall be made up from transmitter and receiver units as currently employed in standard packsets and shall meet all performance requirements applicable to the packsets. Battery boxes and batteries to provide for the extended and variable operational requirements of dry battery repeaters will be furnished by the Government. The manufacturer need furnish only suitable terminal facilities for connection to the external battery supply.

(e) The normal complement of batteries for all packset radiophones, within the size and weight limitations imposed by paragraph 17(e), shall provide operation for five (5) 8-hour days at the standard test duty cycle.

(f) The normal complement of batteries for light-portable radiophones not incorporating speakers, within the size and weight limitations imposed by paragraph 17(f), shall provide operation for not less than two (2) 8-hour days at the standard test duty cycle.

(g) The normal complement of batteries for speaker model light-portable radiophones, within the size and weight limitations imposed by paragraph 17(g), shall provide operation for five (5) 8-hour days at the standard test duty cycle.

17. Housings. (a) The Floor Mounted Standard Rack Cabinet shall be a single vertical metal cabinet of pressed or fabricated steel. It shall be of the dead-front type with hinged doors front and back. It shall accept transmitter/s, receiver/s, and accessory units of standard 19-inch rack width and shall not be less than 63 inches nor greater than 78 inches in over-all height. It shall not be greater than 30 inches in either base dimension.

(b) The Console or Compact-Vertical Cabinet shall be a neat and attractive housing suitable for use in an office or dwelling and operated from controls as specified in the item list of the bid invitation. Maximum height of the compact-vertical cabinet shall not exceed 32 inches. AC Mobile type housing will not be acceptable.

(c) The Pole Mounting Standard Rack Cabinet shall be a single vertical metal cabinet of pressed or fabricated steel. It shall accept transmitter/s, receiver/s, and accessory units of standard 19-inch rack construction and shall not be less than 52 inches nor greater than 65 inches in over-all height. It shall not be greater than 30 inches in either base dimension. It shall be completely weatherproofed and shall provide winter and summer ventilation.

(d) Mobile Equipment shall be housed in sturdy cases or covers designed to permit quick access to the equipment for ease of servicing. The cases shall have no visible openings and shall be so designed to maintain a substantially dust-free interior. Maximum space occupied by all units shall not exceed 1,500 cubic inches, except for high-power and ultrahigh-band mobile equipment and all classes of mobile equipment where two channel unlimited spacing transmitters are included in a single unit, then 2,000 cubic inches will be permitted.

(e) The Packset shall be housed in a substantial case of a form convenient for carrying, but not normally used while in motion. Maximum space occupied by the unit (exclusive of antenna) shall not exceed 800 cubic inches for the single transmitter model and 900 cubic inches for the two transmitter model. The single transmitter model shall not weigh more than 20 pounds and the two transmitter model more than 21 pounds with the full battery complement. It shall be supplied with either a self-contained self-supporting extendable antenna or a separate attachable self-supporting antenna.

(f) The Light-Portable Radiophone Without Speaker shall be housed in a substantial case of the smallest possible physical dimensions to accommodate the required basic units and the power supply. It shall be hand-held or of similar portable style. The microphone shall be either a unit handset type capable of being firmly clipped to, but easily removed from, the basic unit, or shall be an integral part of the basic structure. Total weight of the unit ready for operation shall not exceed 9 pounds for units containing two transmitters, and 8 pounds for units containing a single transmitter. It shall be supplied with either a self-contained self-supporting extendable antenna or a separate attachable self-supporting antenna.

* (g) The Speaker Model Light-Portable Radiophone shall be housed in a substantial case of the smallest possible physical dimensions to accommodate the required basic units and the power supply. It shall be hand-held or of similar portable style. The microphone shall be palm-type capable of being firmly clipped to, but easily removed from, the basic unit. Total weight ready for operation shall not exceed 11 pounds for units containing two transmitters and 10 pounds for units containing a single transmitter. It shall be supplied with either a self-contained self-supporting extendable antenna or a separate attachable self-supporting antenna.

18. Receiver Type. All receivers shall be of the superheterodyne type.

19. Receiver Injection Frequency. The frequency of the injection voltage to all mixer stages shall be crystal controlled. Over the standard range for extended temperature test, the crystal stability shall be such as to prevent variations in the center IF frequency applied to the discriminator in excess of plus and minus the following:

(a) 1 kilocycle for all low-band central station mobile equipment.

(b) 1 kilocycle for all high-band central station and mobile equipment.

(c) 2 kilocycles for all low-band portable and dry-battery powered equipment.

(d) 5 kilocycles for all high-band dry-battery powered and portable equipment.

(e) 4 kilocycles for all ultrahigh-band equipment.

All holders of quartz crystal units shall be hermetically sealed and comply with paragraph 3.9 and applicable tests of Military Specifications MIL-C-3098A.

20. Receiver Channel Arrangement. (a) A Single Channel Receiver shall mean a receiver capable of receiving one carrier frequency and associated sidebands within the specified attenuation limits.

(b) A Two Channel Limited Spacing or Close Spaced Receiver shall mean a receiver capable of receiving either of two frequencies in the same sub-band separated by approximately 250 kilocycles in the low-band, 500 kilocycles in the high-band, or 400 kilocycles in the ultrahigh-band. Where performance on one channel does not meet the specifications because of alignment to the second frequency, the final alignment shall be made at an optimum frequency between the two operating channels. Performance, when so aligned, must meet the specifications for both frequencies. Simultaneous reception is not intended and selection of frequency is ordinarily accomplished by switching the frequency control crystals or crystal controlled oscillators.

(c) A Two Channel Unlimited Spacing Receiver shall mean a receiver or receivers capable of reception on either of two frequencies in the same sub-band separated by more than 350 kilocycles in the low-band, 500 kilocycles in the high-band, or 1 megacycle in the ultrahigh-band. Simultaneous reception is not intended, but rapid selection of either frequency is required unless otherwise stated in the item list of the bid invitation. Nothing shall prohibit the supplier from making use of a design employing separate RF and conversion units for use with a common IF, audio and power supply.

(d) Dual Receivers shall mean two complete receivers capable of simultaneous reception on any two frequencies in a sub-band. Each receiver shall be complete in all details, except nothing shall prohibit the supplier from utilizing a common power supply of sufficient capacity and regulation to supply power to either or both receivers.

21. Receiver Selectivity. The receiver selectivity characteristics shall be such as to accept the frequency modulated carrier and all pertinent sidebands without undue attenuation at low levels and to furnish the maximum protection against unwanted signals on adjacent channels. The width of the receiver pass-band at the 6-decibel points for all "Wide-Band" equipment shall not be less than 20 kilocycles when measured using the 20-decibel noise quieting point as a reference level. The bandwidth at the 80-decibel points shall not be more than:
- (a) 65 kilocycles for all low-band and high-band central station and mobile equipment.
 - (b) 70 kilocycles for all ultrahigh-band central station and mobile equipment.
 - (c) 140 kilocycles for all low-band and high-band portable and dry-battery powered equipment.
22. Receiver Noise Quieting Sensitivity. Over the standard range for extended temperature tests, the maximum input required to produce the standard test signal noise quieting shall be:
- (a) 0.5 microvolt (143 DB below 1 watt) for all low-band central station and mobile equipment.
 - (b) 0.8 microvolt (139 DB below 1 watt) for all high-band central station and mobile equipment.
 - (c) 1 microvolt (137 DB below 1 watt) for all ultrahigh-band central station and mobile equipment.
 - (d) 0.5 microvolt (143 DB below 1 watt) for all low-band packsets.
 - (e) 1 microvolt (137 DB below 1 watt) for all high-band packsets.
 - (f) 0.6 microvolt (141.4 DB below 1 watt) for all low-band light-portable radiophones.
 - (g) 1 microvolt (137 DB below 1 watt) for all high-band light-portable radiophones.
23. Receiver Signal to Noise Sensitivity. The input required to produce the standard test Signal + Noise + Distortion to Noise + Distortion Ratio shall be less than the input required to produce the standard test signal noise quieting as specified in paragraph 22 above.
24. Receiver Temperature Stability. Temperature stability shall be measured by introducing an exact operating frequency signal into the input of the receiver after a suitable "warm-up" period. The IF frequency applied to the discriminator as a result of the conversion or conversions within the set will be measured and recorded as if. The input required to produce 20 decibels noise quieting will be noted and this input increased 6 decibels (doubled). The input frequency will be varied above and below the operating frequency until 20 decibels noise quieting is again obtained. The resultant IF frequency will be measured and recorded at these two points.

The mean of these two values shall be the center frequency (f_c) of the IF pass-band at the 6-decibel points. The difference between the measured IF frequency and the center frequency of the IF pass-band (f_c-f_{if}) over the standard range for extended temperature tests shall not be greater than:

- (a) 1 kilocycle for all low-band central station and mobile equipment.
- (b) 4 kilocycles for all low-band dry-battery powered equipment.
- (c) 1 kilocycle for all high-band central station and mobile equipment.
- (d) 8 kilocycles for all high-band dry-battery powered equipment.
- (e) 3 kilocycles for all ultrahigh-band equipment.

25. Receiver Audio-Power Output. Audio-power output will be measured by introducing into the receiver input a test signal of 1,000 microvolts containing standard test modulation and measuring the audio output in a matched nonreactive load. Total distortion shall not exceed the indicated value for all levels of AF-power output up to the maximum bid specification requirements. Audio-power output of all dry-battery powered equipment shall not decrease more than three decibels over the standard range for extended temperature tests with a fixed volume control setting.

(a) The audio-power output of all central station and mobile equipment shall not be less than one watt. The output shall not decrease more than 30 percent over the standard range for extended temperature tests with a fixed volume control setting. The total distortion, including any remote control line amplifiers, shall not exceed 15 percent.

(b) 100 milliwatts with not more than 15 percent distortion for all packsets and other dry-battery powered equipment incorporating speakers.

(c) 3 milliwatts with not more than 10 percent distortion for all light-portable radiophones and other dry-battery powered equipment employing earphone/s.

26. Receiver Audio-Frequency Response. The receiver audio-frequency response of all central station and mobile equipment shall not vary more than plus 2 to minus 8 decibels from the standard deemphasis curve over the frequency range of 300 to 3,000 cycles per second. The response of all portable equipment shall not vary more than plus 2 to minus 13 decibels from the standard deemphasis curve over the frequency range of 300 to 3,000 cycles per second. The reference frequency shall be 1,000 cycles per second.

* 27. Receiver Squelch. All receivers, except light-portable radiophones without speakers, shall have a squelch circuit incorporated to mute the audio during the absence of signal. Squelch circuits for all central station and mobile receivers shall operate reliably on signals of an amplitude less than required to produce 5 decibels noise quieting at the receiver output and not require more than an increase of 6 decibels above the input necessary for 20 decibels noise quieting to "open" the squelch when the control is in the fully "squelched" position.

* The squelch circuit for receivers normally powered from dry batteries shall operate reliably on signals of an amplitude less than required to produce 10 decibels noise quieting and not require more than 2.5 microvolts of RF input to operate when the control is in the fully "squelched" position.

* Voice frequency deviation of the received carrier up to the full limits of the system shall cause essentially no degradation in squelch performance.

28. Receiver Residual Noise. The audio-frequency hum and noise at the output of all receivers shall be at least 40 decibels below the output produced by the standard test modulation with 1,000 microvolts of RF input over the standard range for extended temperature tests.

29. Receiver Spurious Response. All responses outside the nominal receiver pass-band shall be attenuated as follows:

(a) 80 decibels, including image, for all central station and mobile equipment.

(b) Low-band dry-battery equipment 70 decibels, high-band dry-battery equipment 60 decibels (except one spurious which may be 50 decibels).

30. Transmitter Channel Arrangement. (a) A Single-Channel Transmitter shall mean a transmitter capable of output on only one specified operating frequency.

(b) A Two Channel Limited Spacing or Close Spaced Transmitter shall mean a transmitter capable of output on either of two frequencies within the same sub-band separated by approximately 250 kilocycles in the low-band, 1,600 kilocycles in the high-band, or 400 kilocycles in the ultrahigh-band. Where normal tuning would result in transmitter power output of less than 80 percent of the bid specification requirements because of frequency spacing of the channels, alignment shall be made at an optimum frequency between the two operating channels so as to raise the output to not less than 80 percent of that required by the specifications. Simultaneous transmission is not intended and selection of frequency is ordinarily accomplished by switching the frequency control crystals or crystal controlled oscillators.

(c) A Two Channel Unlimited Spacing Transmitter shall mean a transmitter or transmitters capable of transmission on either of two frequencies in the same sub-band separated by more than 350 kilocycles in the low-band, 1,700 kilocycles in the high-band, or 1 megacycle in the ultrahigh-band. Simultaneous transmission on the two channels is not intended, but selection of either frequency from the control position or positions is required. In order to conserve battery current in mobile units and in dry-battery powered equipment, only the heaters and filaments of the selected channel are to be energized. Nothing shall prohibit the supplier from utilizing a common audio section, power supply, or other circuitry which is independent of the operating frequency.

(d) Dual Transmitters shall mean two complete transmitters capable of simultaneous transmission on any two frequencies in a sub-band. Each transmitter shall be complete in all details, except nothing shall prohibit the supplier from utilizing a common power supply of sufficient capacity and regulation to supply power to either or both transmitters.

- * 31. Transmitter Frequency Control. All transmitters shall be directly crystal controlled. The maximum variation from the specified operating frequency caused by the combined crystal manufacturing tolerance and drift over the standard range for extended temperature tests shall not exceed:

(a) 0.5 kilocycles for all low-band central station and mobile equipment.

(b) 1 kilocycle for all low-band dry-battery powered equipment.

(c) 1 kilocycle for all high-band central station and mobile equipment.

(d) 5 kilocycles for all high-band dry-battery powered equipment.

(e) 3 kilocycles for all ultrahigh-band central station and mobile equipment.

All holders of quartz crystal units shall be hermetically sealed and comply with paragraph 3.9 and applicable tests of Military Specifications MIL-C-3098A.

32. Transmitter Frequency Adjustment. All transmitters shall have provision for manually adjusting the crystal oscillator frequency over a range of not less than 50 parts per million.

33. Transmitter RF-Power Output. The transmitter shall be capable of delivering not less than the following outputs to the antenna feed system:

(a) 50 watts for all low-band and high-band central stations, except 40 watts for high-band central stations above 166 mc.

(b) 10 watts for all ultrahigh-band central station and mobile equipment.

(c) 25 watts for all low-band mobile equipment.

(d) 20 watts for all high-band mobile equipment.

(e) 5 watts for all low-band packsets.

(f) 1 watt for all low-band light-portable radiophones.

(g) 5 watts for all low-band dry-battery powered automatic repeaters.

(h) 750 milliwatts for all high-band light-portable radiophones.

(i) 3 watts for all high-band packsets.

(j) 3 watts for all high-band dry-battery powered automatic repeaters.

(k) 25 watts for all low-power low-band and high-band central stations.

(l) 250 watts for all high-power low-band and high-band central stations.

(m) 50 watts for all high-power low-band mobile equipment.

(n) 40 watts for all high-power high-band mobile equipment.

34. Transmitter Modulation. All transmitters shall employ phase modulation. The modulator shall be capable of producing the full rated system deviation on voice peaks. There shall not be more than 15 percent distortion of recovered audio, including any associate line amplifiers, under standard test modulation conditions.
- * 35. Transmitter Deviation. All transmitters shall be capable of phase modulation deviation of plus and minus 15 kilocycles for wide-band equipment and plus and minus 5 kilocycles for narrow-band equipment. At the time of delivery it is desired that the equipment be adjusted to approximately 90 percent of the above value with normal audio-frequency input levels.
36. Transmitter Deviation Characteristics. Transmitter deviation of all central station and mobile equipment shall not vary more than plus 1 to minus 3 decibels from the standard 6 DB per octave pre-emphasis curve over an audio frequency range of 300 to 3,000 cycles per second. The transmitter deviation of all dry-battery powered equipment shall not vary more than plus 2 to minus 9 decibels from the standard 6 DB per octave preemphasis curve over the frequency range of 300 to 3,000 cycles per second. The reference shall be the deviation at 1,000 cycles per second.
37. Transmitter Deviation Limiter. All equipment of over 3 watts plate power input shall have an automatic frequency deviation control incorporated in the transmitter. The control shall be capable of preventing fundamental deviation beyond the limits of the system irrespective of the voice level into the microphone. It shall not display lag or blocking in operation and shall not introduce distortion in excess of 15 percent. It shall be effective over the entire range of voice frequencies. Distortion will be measured in the audio recovered from the transmitted signal when the transmitter is modulated by a sine-wave of 1,000 cycles per second sufficient to produce 70 percent of the rated system deviation.
38. Transmitter Amplitude Modulation. Amplitude modulation of the transmitter output from all sources, including power supply ripple and voice modulation, shall not exceed 5 percent over the standard range for extended temperature tests.
39. Transmitter Residual Frequency Modulation. The residual frequency modulation of the transmitted carrier from all sources shall be 37 decibels or more below the standard test modulation. Degradation shall not be greater than 10 decibels throughout the standard range for extended temperature tests.
40. Transmitter Temperature Stability. Transmitters shall not suffer more than 3 decibels degradation of drive in any grid circuit or in power output over the standard range for extended temperature tests when aligned at the standard test temperature.

41. Transmitter Spurious Emission. (a) Spurious emissions from central station and mobile transmitters shall be at least 70 decibels (harmonics 60 DB) below the output at the operating frequency, except that in high-power central station equipment the harmonic and spurious emissions shall be at least 85 DR down from the unmodulated carrier.

(b) Spurious emissions from packsets, light-portable radiophones, and other dry-battery powered equipment shall be at least 40 decibels below the output at the operating frequency.

42. Automatic Repeater Operation. The composite arrangement of equipment for automatic repeater operation shall provide the necessary circuitry and features to:

(a) Cause the transmitter to be energized by the presence of a signal whose frequency is within the useful pass-band of the receiver. Automatic operation will result when such signal is of a strength capable of operating the squelch circuit as required under paragraph 27.

(b) Transfer sufficient audio-frequency power from the receiver to modulate the transmitter at its rated deviation. There shall be no appreciable degradation of repeated audio signal.

(c) Establish a transmitter release delay of approximately 3 seconds following the termination of the received signal.

(d) Disconnect the automatic repeat control circuit when local control, extended local control, or remote control operation is affected.

(e) Disconnect the automatic repeat control on those units having two transmitting channels when the nonrepeat channel is selected by the operator.

43. Accessories. A. Accessories to be supplied with each mobile radio. Mobile antennas and special noise suppression equipment are not required to be furnished with each mobile radio.

B. Accessories to be supplied only as specifically enumerated in the item list of the bid invitation.

(a) Weatherproof Housing (mobile). Weatherproof housing shall preclude entrance of water or dust into the basic unit when mounted externally on a vehicle. It shall be easily opened or released to permit rapid access to the equipment for test and inspection. Outlets for all cables and connections shall be gasketed or otherwise provided with effective weatherproof seals. The housing shall be corrosion resistant and of strength not less than provided by 16-gage steel. It shall be finished according to the best automotive or Army-Navy standard practices for application of baked enamel or lacquer over a rust inhibiting or rust resisting plate or primer. Bidder will furnish blueprint and description of the housing he proposes to supply.

(b) Headphone and Microphone (light-portable radiophone and/or packset). A noise-excluding headphone and noise-cancelling lip-mike combination for aircraft or similar use. The associated cables and controls shall provide press-to-talk and headphone volume control.

(c) Carrying Case for Light-Portable Radiophone and/or Packset. A heavy-duty weather resistant canvass carrying case complete with straps and designed to fit the appropriate basic unit. Canvass cases shall be an appropriate soil resisting color (plain white not acceptable). Carrying cases for the light-portable radiophone shall be padded for added protection. Pack-set cases need not be padded.

(d) Wet Cell Power Supply for Light-Portable Radiophone and/or Packset. A wet cell power pack adaptable to replace the standard dry-battery pack unit.

(e) Auxiliary 6/12-volt DC Power Supply for Packset. Auxiliary power supply to provide operation of the packset from a 6 or 12 volt DC power source. It may be a separate plug-in unit or built so as to attach to the basic unit in place of the dry-battery pack. The unit shall be complete with connectors and cables of which the power supply cable shall not be less than 6 feet in length.

(f) Auxiliary 117-volt AC Power Supply for Packset. Auxiliary power supply to provide operation of the packset from 110-120 volt AC power source. It may be a separate plug-in unit or built so as to attach to the basic unit in place of the dry-battery pack. The unit shall be complete with connectors and cable of which the power supply cable shall not be less than 6 feet in length.

(g) Long-Wire Antenna for Light-Portable Radiophone or Packset. A long-wire phosphor-bronze antenna and associated impedance matching transformer shall be supplied.

(h) Central Station Control Units. (See section 14).

